WOOD PRESERVING CHEMICALS IN CALIFORNIA LANDFILL LEACHATE PHASE 1 STUDY

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EXECUTIVE SUMMARY

This study responds to concerns related to the disposal of treated wood waste in Class 2 and Class 3 (non-hazardous) landfills in California. Results of leachate monitoring from five California landfills are evaluated for chemicals used in treated wood. The chemical levels are compared to screening levels that are determined from applicable drinking water standards or guides.

While this study's focus is on the chemicals used to treat wood, treated wood waste is clearly not the only potential source of these chemicals in landfills. The metals, arsenic, chrome, copper, and zinc, exist naturally in soil and groundwater, in normal municipal and industrial waste, and through the natural food change. The polycyclic aromatic hydrocarbons, naphthalene and benzo(a)pyrene exist naturally in petroleum and coal, as combustion by-products and in normal municipal and industrial waste. Although the fraction of chemicals contributed by treated wood waste to landfill leachate is not known, conclusions about the levels of these chemicals found in leachate can still be made.

These results support a conclusion that, except for arsenic, metals from treated wood chemicals in landfill leachate are below drinking water standards and, therefore, present no significant risk of contaminating drinking water. For arsenic, while nearly all results were below the California MCL, landfill modeling may be necessary to evaluate risk. A leachate level of approximately 0.02 to 0.05 mg/l arsenic would be conservative as representing the high end of current data. Organic chemicals which might result from treated wood products were either below the drinking water standard or below the limit of detection for the analytical method used.

1. INTRODUCTION

Preservative treated wood is used widely throughout California and the world. Creosote has been used to preserve wood since the late 19th century and was critical to the successful development of the railroad transportation system that benefits all today. Other preservatives entered the marketplace in the 1950s with numerous improvements over the years. Treated wood products are now common in uses such as utility poles, railroad ties, pilings, sign and guard rail posts, fencing, outdoor decks, public boardwalks, foundation sill plates, and agricultural supports. While treated wood will often last for 30 years or more, southern pine treated lumber used in residential decks and walkways is often replaced within 10 years or so due to appearance deterioration from weathering and/or remodeling. Thus, treated wood has been a part of the waste stream in California for many years and will continue to be so.

Most treated wood waste is and has been disposed in municipal solid waste landfills. Treated wood waste is not a hazardous waste according to US EPA hazardous waste regulations. California regulations would classify most treated wood as a non-RCRA (California-only) hazardous waste based on total threshold limit concentrations (TTLC) of the preservative chemicals and/or the aquatic toxicity characteristic standard. However, the state Department of Toxic Substances (DTSC) has issued letters granting variance from the hazardous waste disposal requirements provided that the treated wood waste is disposed in lined sections of landfills. Treated wood waste from utility companies is exempt from hazardous waste regulation by legislation.

The purpose of this study is to document the levels of wood preserving chemicals in the leachate of actual landfills and evaluate whether disposal of treated wood has caused any unacceptable impacts.

It is important to note that the presence in leachate of chemicals sometimes used for wood preservation does not prove that they came from preserved wood. There are other, potential sources that may be as or more significant than the disposed treated wood. Arsenic, chrome, copper, and zinc are naturally occurring, common elements in the earth's crust. Naphthalene and benzo(a)pyrene are found naturally in coal, petroleum, and as combustion by-products. Agricultural or other industrial waste may contain the same chemicals. Bio-chemical reactions within the landfill may dissolve and mobilize trace metals from waste or cover soil.

This evaluation considers landfill leachate. Leachate is the liquid that collects above a liner that is installed below the landfill waste. Modern landfills are designed so that excess liquid, the leachate, will be collected on the liner and then be drained or pumped away for treatment so that the leachate does not leak to and impact groundwater. In unlined landfills, such leachate may migrate to and potentially have a negative impact on groundwater quality. Thus, leachate is important to understand since it represents the worst-case potential risk to groundwater.

2. LANDFILL LEACHATE DATA COLLECTION

Landfills that have liners are required to analyze leachate and report results to the Regional Water Quality Control Boards (RWQCBs) on at least an annual basis according to their permits. The reports are maintained by the RWQCBs.

For this Phase I study, data were obtained for five landfills. Chemicals that are present in wood preservatives were selected for consideration. As noted above, the presence in the leachate of the selected chemicals could result from leaching from preserved wood products or from other sources.

3. EVALUATION OF LANDFILL LEACHATE DATA

3.1 COMPARISON OF LEACHATE CONCENTRATIONS TO CRITERIA

While it is not really appropriate to compare concentrations of chemicals in leachate to drinking water standards because the concentrations are necessarily higher than would be found in drinking water, these criteria can be used as an initial screen. If concentrations in leachate are lower than the drinking water standard, than certainly there is no cause for concern that the waste generating that leachate is hazardous under the current disposal practices. It is also possible to compare data from facilities which do not accept treated wood waste, to data from those who do accept such waste.

3.2 EVALUATION OF THE LANDFILL LEACHATE DATA

Data on leachate for each landfill are summarized below. Data from individual landfills is attached as Appendix 1. Review of the summary leachate results indicates that none of the levels for metals exceed the current drinking water standards. However, the summary levels of arsenic at two of the five landfills exceed the 2006 drinking water standard by a factor of about 2. Although pentachlorophenol and benzo(a)pyrene were not detected in any samples, the Method Detection Limit (MDL) for EPA Method 8270C was higher than the drinking water standard, so comparisons cannot be made.

Summary of Leachate Data

Constituent	Units	Kiefer	Yolo Co.	Hay Rd [1]	Western Reg.	Buena Vista	EPA Method Deteciton Limits[2]	Screening Level
pH	s.u.	6.68	6.94		6.98	8.44		
					(Dissolved)			
Arsenic	mg/l	0.0080	0.0170	0.0097	0.0195	0.0080	0.0050	**0.05 (0.01)**
Chromium	mg/l	ND	0.0170	0.0106	ND	0.0041	0.0100	**0.0500**
Chromium VI	mg/l	ND	0.0042	0.0063	ND	ND	0.0100	**0.0210**
Copper	mg/l	ND	0.0030	0.0147	ND	ND	0.0100	**1.0000**
Zinc	mg/l	ND	0.0227		ND	0.1900	0.0100	**5.0000**
Pentachlorophenol	µg/l	ND	ND	ND	ND	NR	50.0	**1**
Naphthalene	µg/l	ND	80	13	3.15	NR	1.0	**170**
Benzo(a)Pyrene	µg/l	NR	ND	ND	ND	NR	10.0	**0.2**

Treated Wood Accepted?	No	No	Yes	Yes	Yes

NOTES:
NR = Not Reported
ND = Not Detected
(1) Hay Road results shown for metals are average of 2001 and 2002 results with averages calculated using detection
limits where analytes were not detected. For napthalene, result is highest detection.
(2) Highest detection limit for results reported as Not Detected for metals, MDL for
8260B and 8270C analytes

Comparing leachate arsenic levels to the landfill's treated wood waste acceptance policy is inconclusive. The highest level, from Yolo, occurs at a landfill that does not accept treated wood. The next highest, Western, does accept treated wood waste. The remaining three landfills have arsenic in leachate within a narrow range between 0.008 and 0.010 mg/l, just below the MCL. Of these, two accept and one does not accept treated wood waste. This data suggest that some other factor or factors other than accepting treated wood waste affect arsenic levels in leachate.

Levels of arsenic in leachate do not support a conclusion that treated wood is the source. The levels found in the leachate are within the same range as natural groundwater in much of California. The SWRCB reports that 1038 of about 16,000 public drinking water wells produce water containing 0.010 mg/l or more arsenic (Wycoff, 2002). The median arsenic concentration in soil in California is 2.7 mg/kg (Bradford, 1996). Used as daily cover, even this "clean" soil could contribute significant quantities of arsenic, especially considering the potential for dissolution of soil minerals by organic compounds and/or bacterial activity (Welch, 2000). Mining, agricultural, incinerator ash, and glass wastes may also contribute significant levels of arsenic (Welch, 2000). EPA has documented that the quantity of arsenic from non-hazardous mining wastes far exceeds the arsenic from wood preserving (Fiedler, 2001). Thus, it is possible that the levels of arsenic in leachate may be relatively constant and unaffected by treated wood disposed in the landfills.

4. CONCLUSION

4.1 PHASE 1 CONCLUSIONS

Levels of the wood preservative chemicals studied in landfill leachate included arsenic, chromium, hexavalent chromium, copper, zinc, pentachlorophenol, naphthalene, and benzo(a)pyrene. Other potential sources of these chemicals also exist in landfills and may be significant. When compared to screening levels derived from applicable drinking water standards or guidance, of the metals, only arsenic exhibited any levels in leachate near or above the screening level. Organic chemicals which might result from treated wood products were either below the drinking water standard or below the limit of detection for the analytical method used.

Arsenic levels in leachate ranged from less than 0.001 to 0.060 mg/l in representative samples. Under typical landfill conditions, upper range arsenic levels of 0.01 to 0.02 mg/l are common. While these levels are lower than the current CMCL, they exceed the USEPA MCL by a factor of up to two. The data viewed in this study would indicate that it would be environmentally and health risk protective to use an arsenic-in-leachate level of 0.02 to 0.05 mg/l (two to five times the USEPA MCL and one-fifth of up to equaling the CMCL) to model potential risks resulting from leaks of leachate from landfills.

The fraction of the overall waste stream going to landfills that is treated wood has been estimated to be approximately 0.5 to 1.0 %. As treated wood now in service is disposed, the fraction may increase slightly, but is expected to remain at about this level. Thus, current leachate should be predictive of future leachate if disposal practices are not changed.

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6. Appendix 1

TABLE 1-1. KEIFER LANDFILL RESULTS*

Constituent	Units	1995	1996	1997	1998	1999	2000	2001	2002	EPA Method Detection Limits[1]	Screening Level
pH (2)									6.68		NA
Arsenic	mg/l	0.0090	0.0020	0.0093	ND	ND	ND	ND	0.0080	0.0020	**0.050**
Chromium	mg/l	ND	0.0006	ND	ND	ND	0.0046	ND	ND	0.0050	**0.050**
Chromium VI	mg/l	ND	NA	ND	ND	ND	ND	ND	ND	0.0050	**0.021**
Copper	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	0.0020	**1.000**
Zinc	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	0.0030	**5.000**
Pentachlorophenol	µg/l	ND	ND	ND	ND	ND	ND	ND	ND	50.0	**1.0**
Naphthalene	µg/l	1.0	0.4	ND	ND	ND	ND	ND	ND	0.1	**170.0**
Toluene	µg/l	15.0	22.0	85.0	6.7	ND	2.2	1.7	ND	0.1	NA

* Based on 2002 Annual Report, Table 6-3 Annual Monitoring Results of Leachate Constituents of Concern

NOTES:

(1) Detection limit estimated to be 10x MDL for metals and MDL for 8260B and 8270C analytes

(2) pH number in 2002 is average of 5 months reported.

TABLE 1-2. HAY ROAD LANDFILL RESULTS*

Constituent	Units	Location	1998	1999	2000	2001	2002	EPA Method Detection Limits[1]	Screening Level
Arsenic	mg/l	S-1	0.0056	0.0070	0.0118	0.0120	0.0088		0.05
Arsenic	mg/l	S-2.1			0.0146	0.0120	< 0.0050		
Arsenic	mg/l	S2.2A	0.0054	0.0376	< 0.0050				
Arsenic	mg/l	S-2.2B	0.0131	0.2350		< 0.0050	< 0.0050		
Arsenic	mg/l	S-5.1A				< 0.0050	0.0290		
Arsenic	mg/l	S-5.1B				< 0.0050	0.0200		
Arsenic	mg/l	S-9.1A				0.0089	0.0110		
Arsenic	mg/l	S-9.1B				0.0091	0.0110		
Arsenic	mg/l	S-11.1		0.0172	< 0.0050	0.0053	< 0.0050		
Arsenic	mg/l	S-11.2			0.0211	< 0.0050			
Arsenic	mg/l	Average				0.0075	0.0119		
Chromium	mg/l	S-1	< 0.0100	< 0.0100	< 0.0100	< 0.0100	< 0.0100		0.05
Chromium	mg/l	S-2.1			< 0.0100	< 0.0100	< 0.0100		
Chromium	mg/l	S2.2A	< 0.0100	0.0394	0.0216				
Chromium	mg/l	S-2.2B	0.0144	0.3500		< 0.0100	< 0.0100		
Chromium	mg/l	S-5.1A				< 0.0100	0.0190		
Chromium	mg/l	S-5.1B				< 0.0100	0.0100		
Chromium	mg/l	S-9.1A				< 0.0100	< 0.0100		
Chromium	mg/l	S-9.1B				< 0.0100	< 0.0100		
Chromium	mg/l	S-11.1		0.0314	0.0101	< 0.0100	< 0.0100		
Chromium	mg/l	S-11.2			0.0215	< 0.0100			
Chromium	mg/l	Average				0.0100	0.0111		
Chromium VI	mg/l	S-1	< 0.0100	< 0.0050	< 0.0050	< 0.0050	< 0.0050		0.021
Chromium VI	mg/l	S-2.1			0.0068	0.0069	< 0.0050		
Chromium VI	mg/l	S2.2A	< 0.0100	< 0.0050	< 0.0050				
Chromium VI	mg/l	S-2.2B	< 0.0100	< 0.0050		< 0.0050	< 0.0050		
Chromium VI	mg/l	S-5.1A				0.0160	< 0.0050		
Chromium VI	mg/l	S-5.1B				< 0.0050	< 0.0100		

Chromium VI	mg/l	S-9.1A				< 0.0050	0.0068		
Chromium VI	mg/l	S-9.1B				< 0.0050	< 0.0050		
Chromium VI	mg/l	S-11.1		< 0.0050	< 0.0050	< 0.0050	0.0068		
Chromium VI	mg/l	S-11.2			0.0063	< 0.0050			
Chromium VI	mg/l	Average				0.0064	0.0061		
Copper	mg/l	S-1	< 0.0100	0.0115	< 0.0100	< 0.0100	< 0.0100		1
Copper	mg/l	S-2.1			< 0.0100	< 0.0100	< 0.0100		
Copper	mg/l	S2.2A	0.0108	0.1030	0.8550				
Copper	mg/l	S-2.2B	< 0.0100	0.8170		< 0.0100	< 0.0100		
Copper	mg/l	S-5.1A				< 0.0100	< 0.0100		
Copper	mg/l	S-5.1B				< 0.0100	0.0400		
Copper	mg/l	S-9.1A				0.0130	< 0.0100		
Copper	mg/l	S-9.1B				0.0550	< 0.0100		
Copper	mg/l	S-11.1		0.0619	< 0.0100	0.0120	< 0.0100		
Copper	mg/l	S-11.2			0.1185	< 0.0100			
Copper	mg/l	Average				0.0156	0.0138		
Pentachlorophenol	µg/l		No detects resulting from semi-volatile analyses					50	1
Naphthalene	µg/l	LW-3				13.0	13.0	1.0	170
Naphthalene	µg/l	S-1				0.2	ND		
Naphthalene	µg/l	S-2.1			4.5	3.9	ND		
Naphthalene	µg/l	S2.2A			68.0	ND	ND		
Naphthalene	µg/l	S-2.2B	15.7	2.7		ND	ND		
Naphthalene	µg/l	S-5.1A				ND	ND		
Naphthalene	µg/l	S-5.1B				ND	ND		
Naphthalene	µg/l	S-9.1A				ND	ND		
Naphthalene	µg/l	S-9.1B				ND	ND		
Naphthalene	µg/l	S-11.1				ND	ND		
Naphthalene	µg/l	S-11.2				ND	ND		
Naphthalene	µg/l	Average				ND	ND		
Benzo(a)Pyrene	µg/l		No detects resulting from semi-volatile analyses					10	0.2

* Based on 2002 Annual Report, Appendix C, Historical Results Table. Last Five Years Selected.
(1) < values indicate detection limit for metals; MDL or highest A35detection limit reported for 8260B and 8270C analytes

TABLE 1-3. YOLO COUNTY CENTRAL LANDFILL RESULTS*

Constituent	Units	Leachate Pump Stations		Screening Level
		LPS1	LPS2	
pH	s.u.	6.55	7.03	
Elec. Conductivity	µmhos/cm	4,197	1,637	
Total Dissolved Solids	mg/l	2,260	4,700	
Arsenic	mg/l	0.0210	0.0130	**0.050**
Chromium	mg/l	0.0210	0.0130	**0.050**
Chromium VI	mg/l	0.0050	0.0034	**0.021**
Copper	mg/l	0.0025	0.0034	**1.000**
Zinc	mg/l	0.0073	0.0380	**5.000**
Semi-Volatile Organics				
Acenaphthene	µg/l	11.0	<0.96	
Acenaphthylene	µg/l	<11	<1.1	
Anthracene	µg/l	<11	<1.1	
Benzo(a)anthracene	µg/l	<8.9	<0.84	
Benzo(b)fluoranthene	µg/l	<8.8	<0.84	
Benzo(k)fluoranthene	µg/l	<11	<1.1	
Benzo(a)pyrene	µg/l	<8.4	<0.80	**0.2**
Benzo(ghi)perylene	µg/l	<11	<1.1	
Chrysene	µg/l	<9.7	<0.91	
Dibenz(a,h)anthracene	µg/l	<9.7	<0.91	
Fluoranthene	µg/l	<9.1	<0.86	
Fluorene	µg/l	<11	<1.1	
Indeno(1,2,3-cd)pyrene	µg/l	<8.6	<0.82	
2-Methylphenol (o-Cresol)	µg/l	<18	<1.7	
4-Methylphenol (p-Cresol)	µg/l	600.0	<1.4	
Naphthalene	µg/l	80.0	<1.2	**170.0**
Pentachlorophenol	µg/l	<180	<17	**1.0**
Phenanthrene	µg/l	<9.8	<0.92	
Phenol	µg/l	460.0	<4.8	
Pyrene	µg/l	<10	<0.96	

Background Wells Results for 19 and 20 August 2002 Sampling

Constituent	Units	LTPZD	OW17
Arsenic	mg/l	0.0027	0.0036
Chromium	mg/l	0.0240	0.0140
Chromium VI	mg/l	0.0180	0.0039
pH	s.u.	7.55	7.65
Electrical Conductivity	µmhos/cm	4,440	1,986

* Based on 2002 Annual Report Results of 13 August 2002 Sampling Event

< values indicate limit of detection

TABLE 1-4. WESTERN REGIONAL SANITARY LANDFILL RESULTS*

Constituent	Units	Leachate Monitoring Locations				EPA Method Deteciton Limits[1]	Screening Level
		M-11	M-12	M-13	M-14		
pH	s.u.	7.50	6.84	6.79	6.79		
Elec. Conductivity	µmhos/cm	3,790	4,220	4,890	4,910		
Total Dissolved Solids	mg/l	2,200	2,300	2,900	2,800		
Arsenic (Dissolved)	mg/l	0.0130	0.0180	0.0170	0.0300		**0.050**
Chromium (Dissolved)	mg/l	<0.01	<0.01	<0.01	<0.01		**0.050**
Chromium VI (Dissolved)	mg/l	<0.005	<0.005	<0.005	<0.005		**0.021**
Copper (Dissolved)	mg/l	<0.01	<0.01	<0.01	<0.01		**1.000**
Zinc (Dissolved)	mg/l	<0.02	<0.02	<0.02	0.0210		**5.000**
Pentachlorophenol	µg/l	No SVOCs detected				50.0	**1.0**
Naphthalene	µg/l	1.1	5.6	4.9	1.0		**170.0**

* Based on 2002 Annual Report Fourth Quarter 2002 Results

< values indicate detection limit; MDL for pentachlorophenol for EPA Method 8270C

TABLE 1-5. BUENA VISTA LANDFILL RESULTS*

Constituent	Units	Result	Screening Level
pH	s.u.	8.44	
Elec. Conductivity	µmhos/cm	3,720	
Total Dissolved Solids	mg/l	3,400	
Arsenic	mg/l	0.0080	**0.050**
Chromium	mg/l	0.0041	**0.050**
Chromium VI	mg/l	<.0025	**0.021**
Copper	mg/l	<.0022	**1.000**
Zinc	mg/l	0.1900	**5.000**

* Based on 2001 Annual Report Leachate Sump (L-2) Results
< value indicates detection limit